TCS-08 Near Real-Time Satellite Field Program Support and Validation

[Jeff Hawkins, Kim Richardson, Tom Lee, Buck Sampson, Steve Miller, Arunas Kuciauskas][1,]
[Chris Velden, Derrick Herndon, Tim Olander, Tony Wimmers][2]
Joe Turk[3], and John Kent[4]

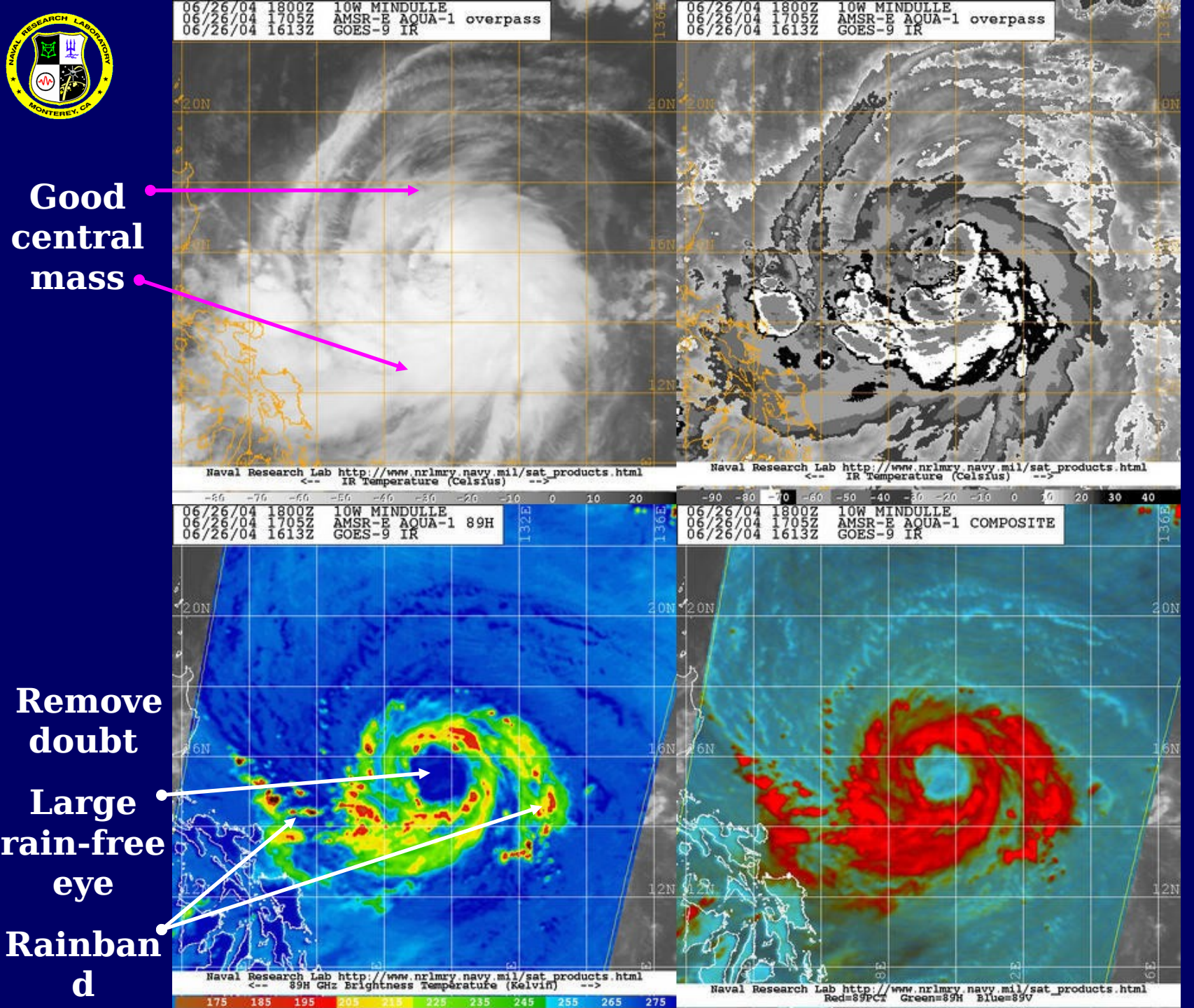
Organizations:

[1]Naval Research Laboratory, Monterey, CA

[2]Cooperative Institute for Meteorological Satellite Studies, Madison, WI

[3]Jet Propulsion Laboratory, Pasadena, CA
[4]Science Applications International Inc, Monterey, CA

Sponsors:
Office of Naval Research (ONR)
SPAWAR PEO C4I&Space/PMW-120



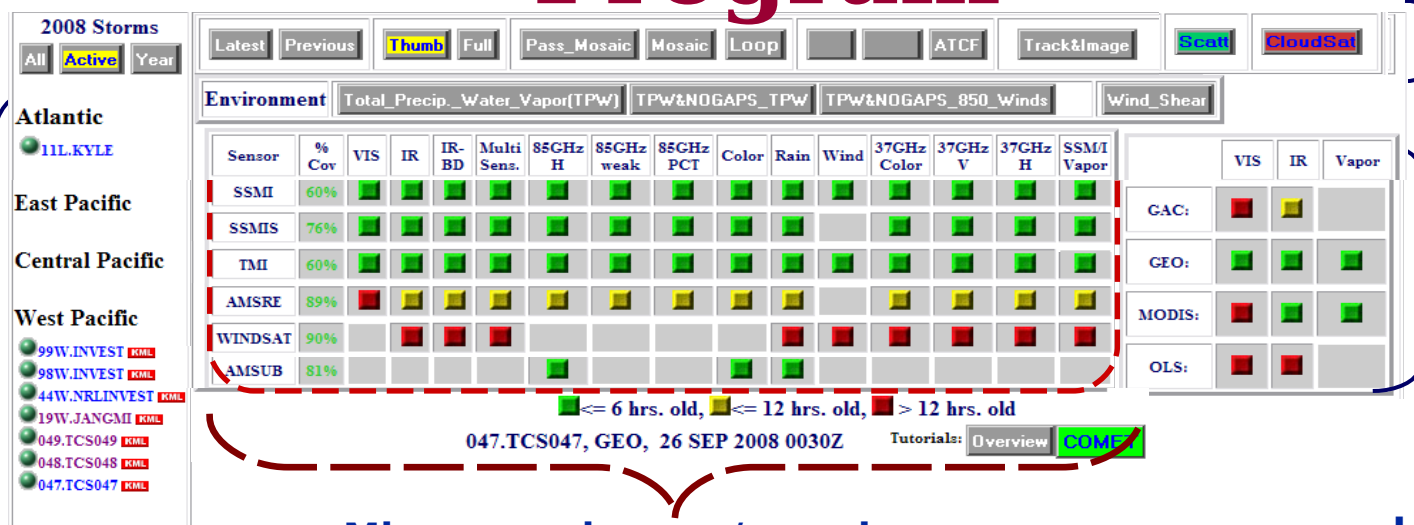
Good central mass

Remove doubt

Large rain-free eye

Rainband

TCS-08 Field Program

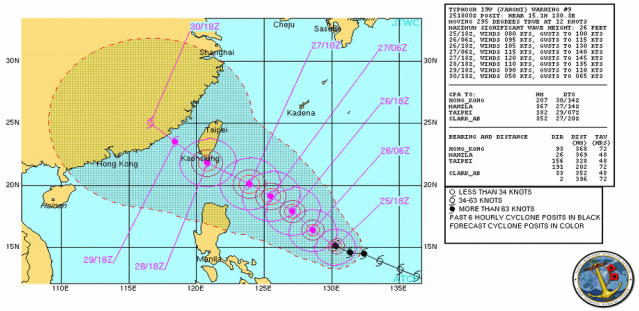


Storm Basins & Names

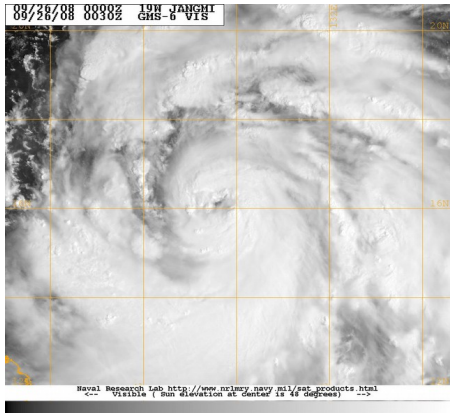
Scatterometer & CloudSat

Vis/IR imagery suite

Microwave imager/sounder product suite



Automated Tropical Cyclone Forecasting (ATCF) System warning graphic

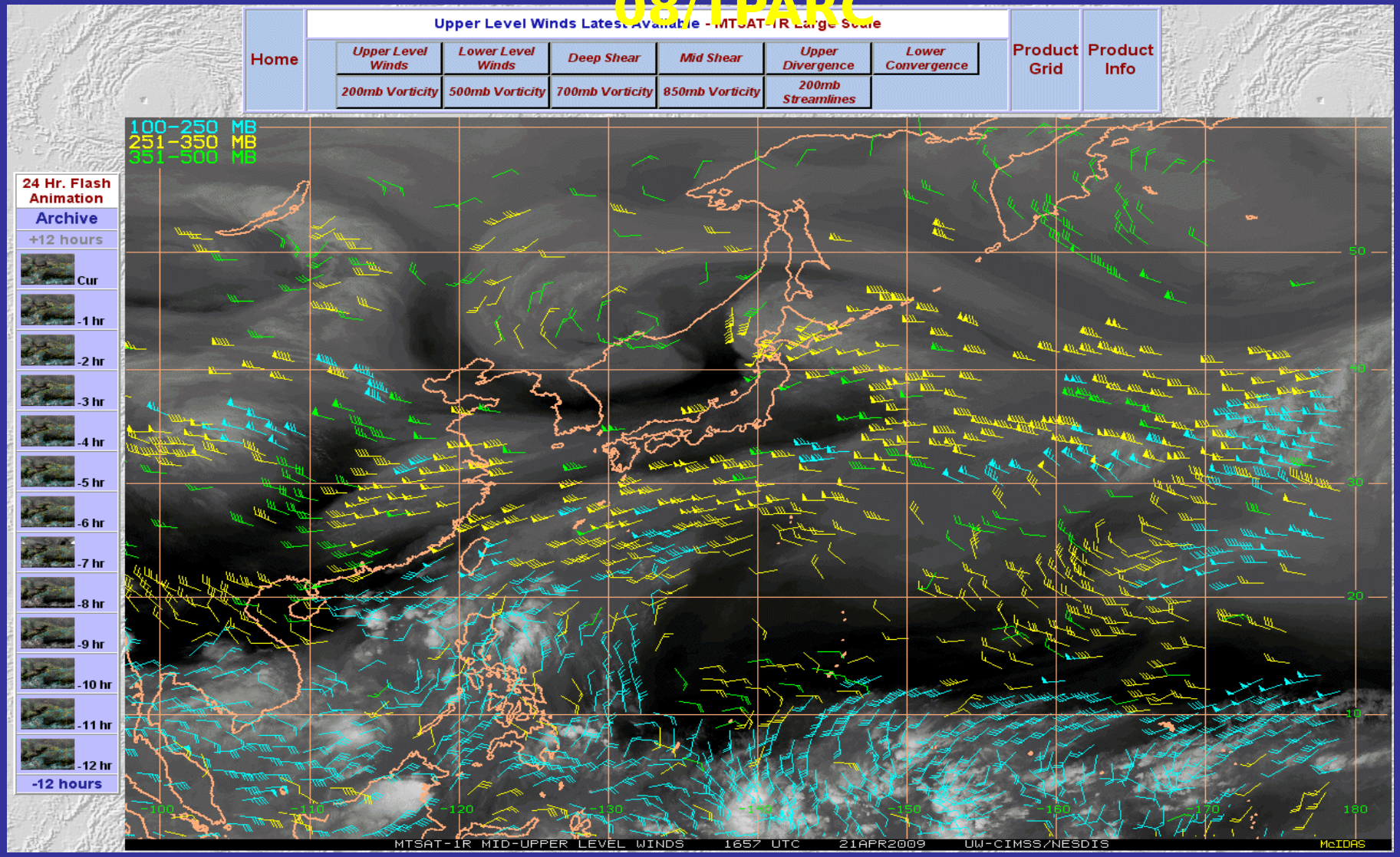


Latest 1-km Visible/IR imagery (GEO/LEO)

30 minute MTSAT refresh with AVHRR/OLS as available

NRL Satellite Page

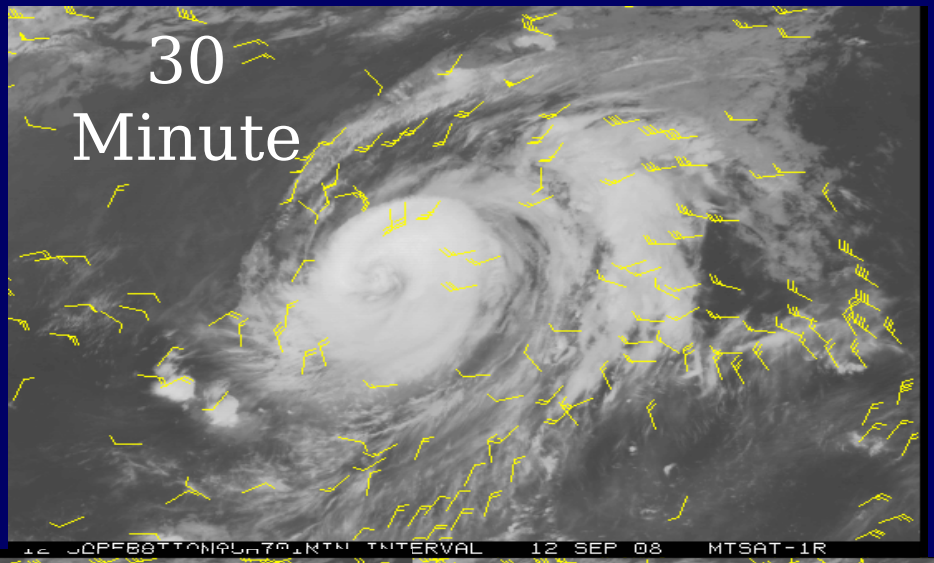
Cloud and water vapor-tracked winds: TCS-08/TPARC

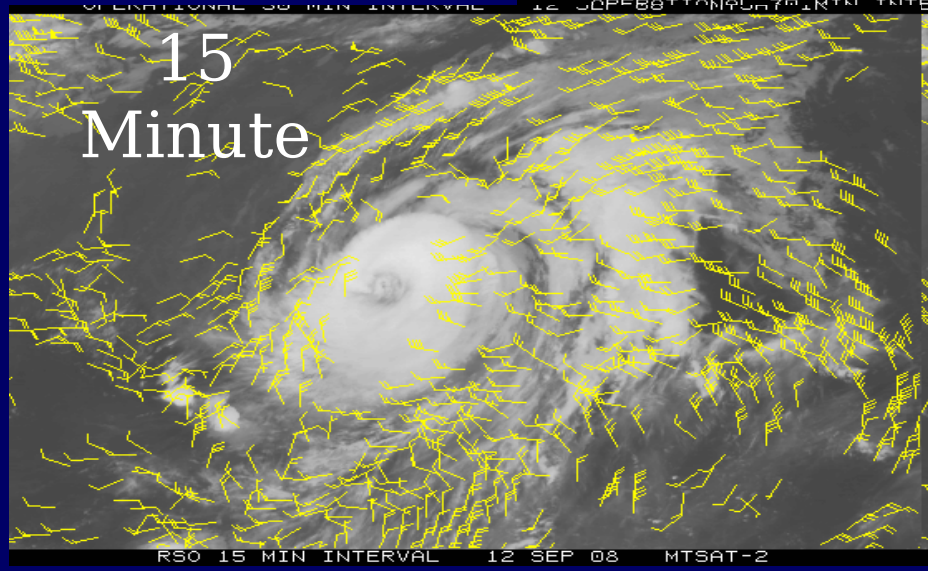


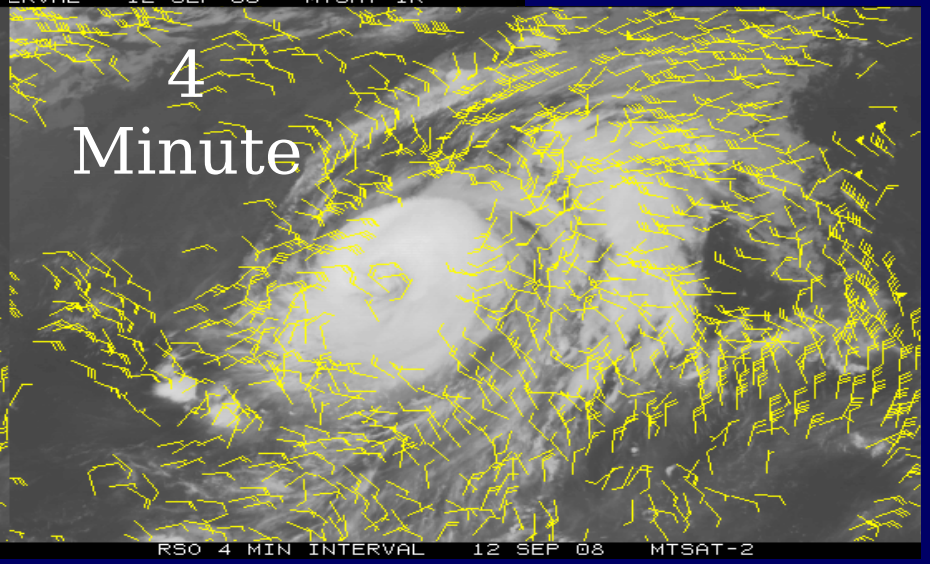
CIMSS MTSAT-1R hourly winds now a routinely available to JTWC. The vectors are disseminated to NRL-MRY for NOGAPS model assimilation.

Velden/Stettner

MTSAT Rapid Scan Wind Vectors







NOGAPS 4DVAR assimilation and model forecast impact studies underway

Future plans for COAMPS-TC assimilation experiments

TCS-08 Satellite Cal/Val

WC-130J Penetrations: TC Intensity (MSLP & Max Winds):

Single

Doubl

Triple

13W Nuri

15 W Sinlaku

19 W Jangmi

03 Center Fixes

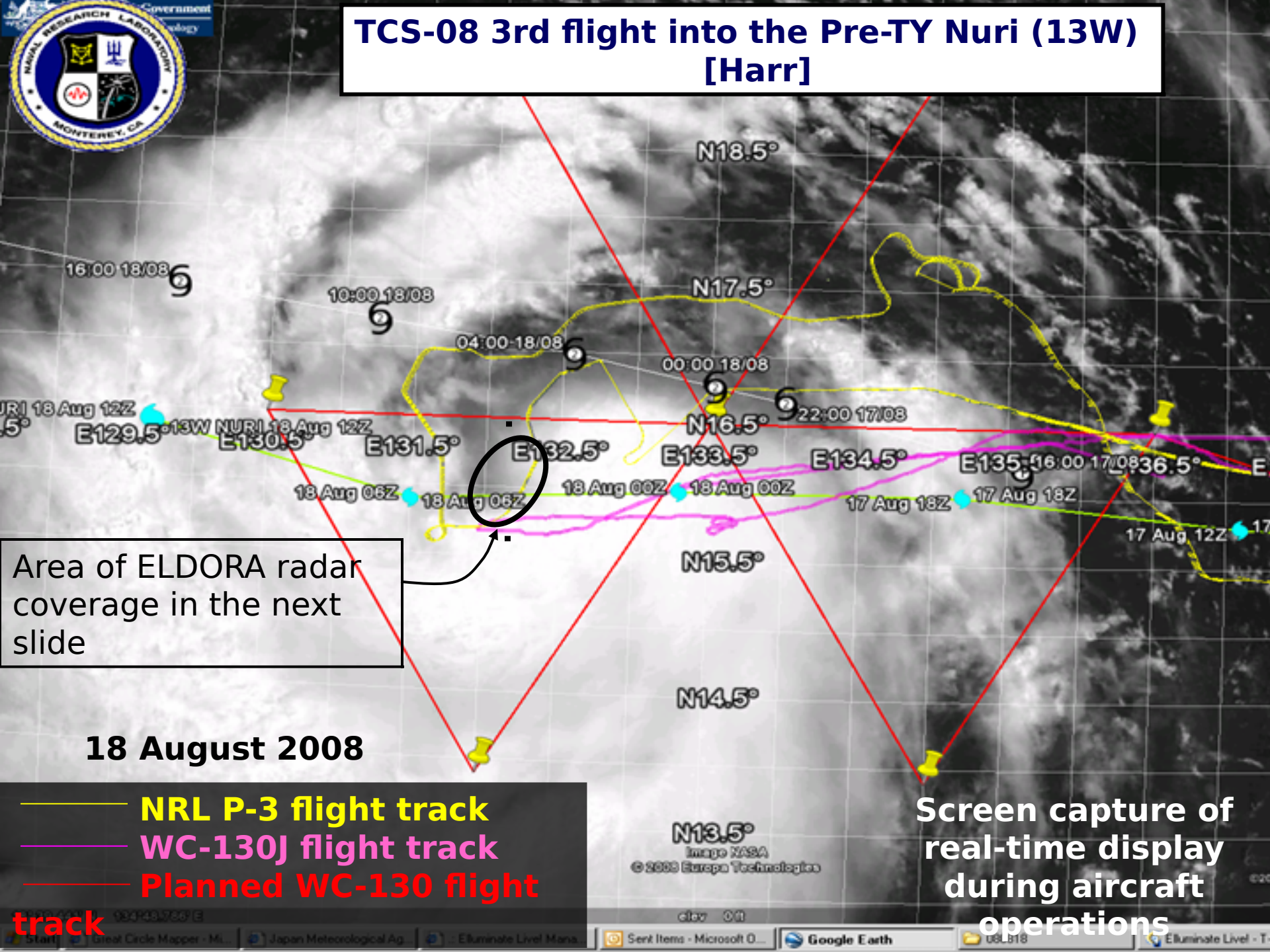
11 Center Fixes

8 Center Fixes

1 7 14 21 28 7 14 21 28

August Time Line September

TCS-08 3rd flight into the Pre-TY Nuri (13W) [Harr]



Area of ELDORA radar coverage in the next slide

18 August 2008

NRL P-3 flight track

WC-130J flight track

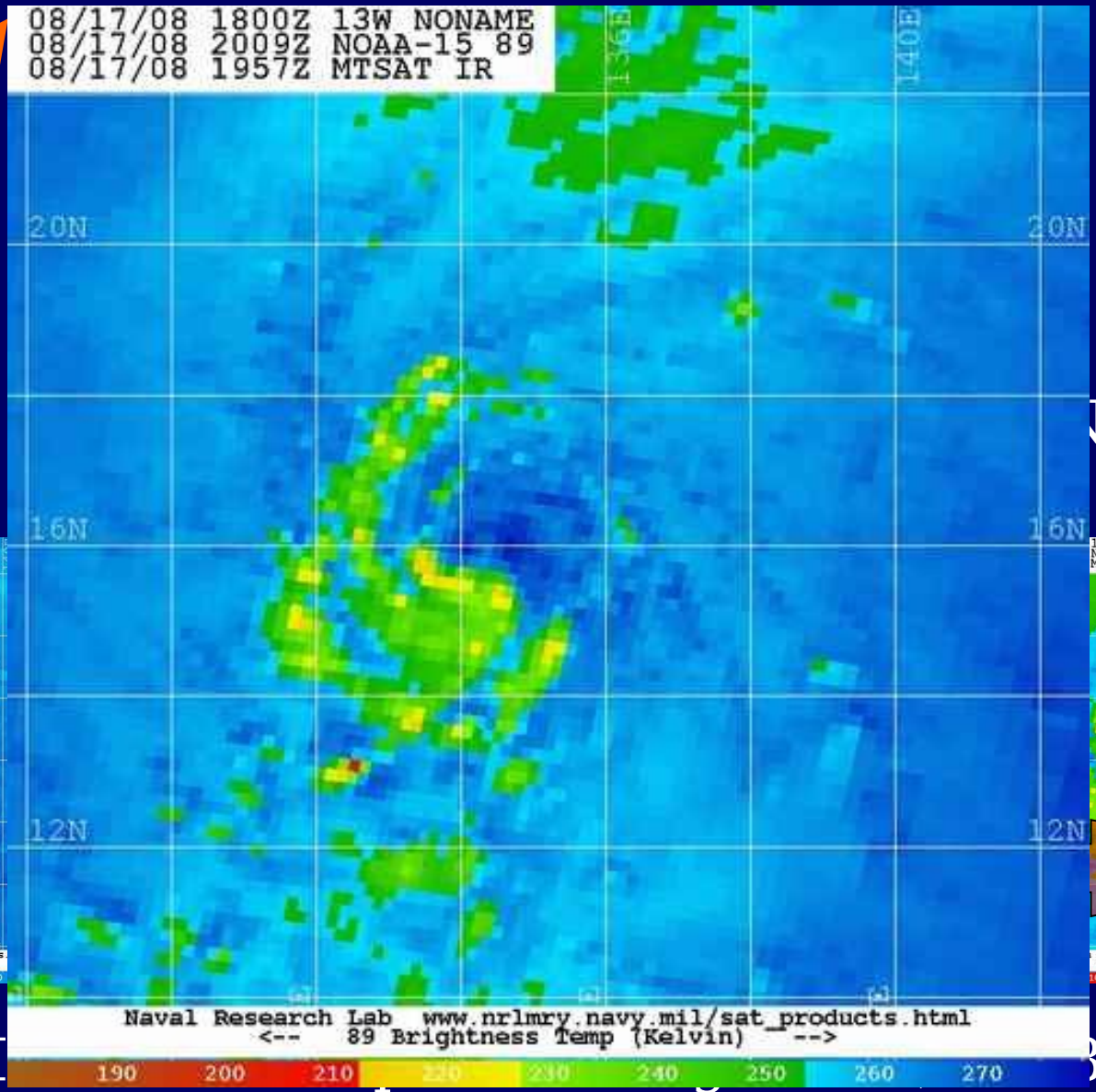
Planned WC-130 flight track

Screen capture of real-time display during aircraft operations

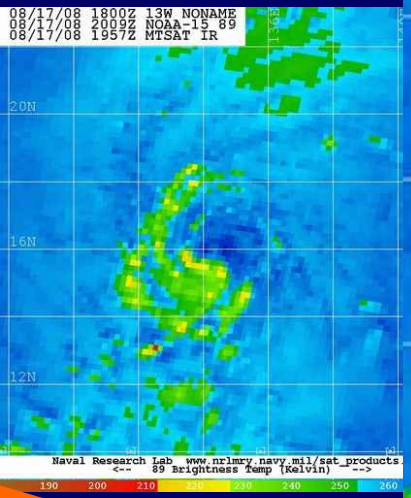
TCS-08 Satellite Cal-Val

3 Engines: One WC-130J Nuri penetration – then home (Guam)

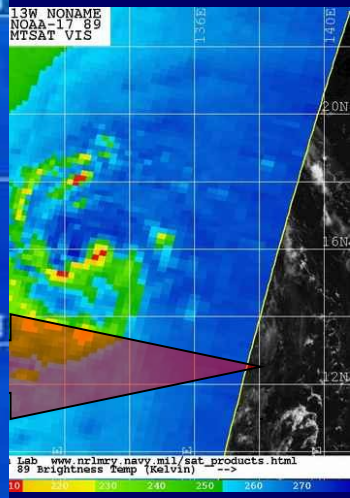
TCS-08 Satellite Cal-Val



NOAA-15
2009Z



NOAA-17
0123Z



AM 3

Analysis of Sat-Based TC Intensity Estimation in the WNP

WC-130J storm center fixes within +/- ~4 hours of corresponding AMSU overpasses

Storm	yyyymmddhhmm	lat	lon	mslp	msw	amsu_pass(ddhhmm)
13W	200808172300	15.77N	133.62E	994	45	172008
13W	200808182200	16.95N	127.25E	977	78	182034
15W	200809090600	17.87N	125.25E	986	62	090511
15W	200809100600	20.24N	124.33E	954	90	100501
15W	200809100800	20.42N	124.37E	946	100	100807
15W	200809111300	21.80N	124.75E	940	90	110819
15W	200809121700	23.83N	123.22E	953	90	121713
15W	200809180400	30.33N	130.24E	981	65	180818
15W	200809190400	33.02N	135.09E	975	75	190755
15W	200809191800	34.18N	139.22E	978	65	192014
19W	200809242100	13.50N	134.18E	991	55	242001
19W	200809260000	15.77N	129.65E	973	75	251640
19W	200809260200	16.10N	129.35E	967	80	260506
19W	200809270900	21.09N	124.78E	904	135	270832

TCS-08 satellite validation cases were limited!

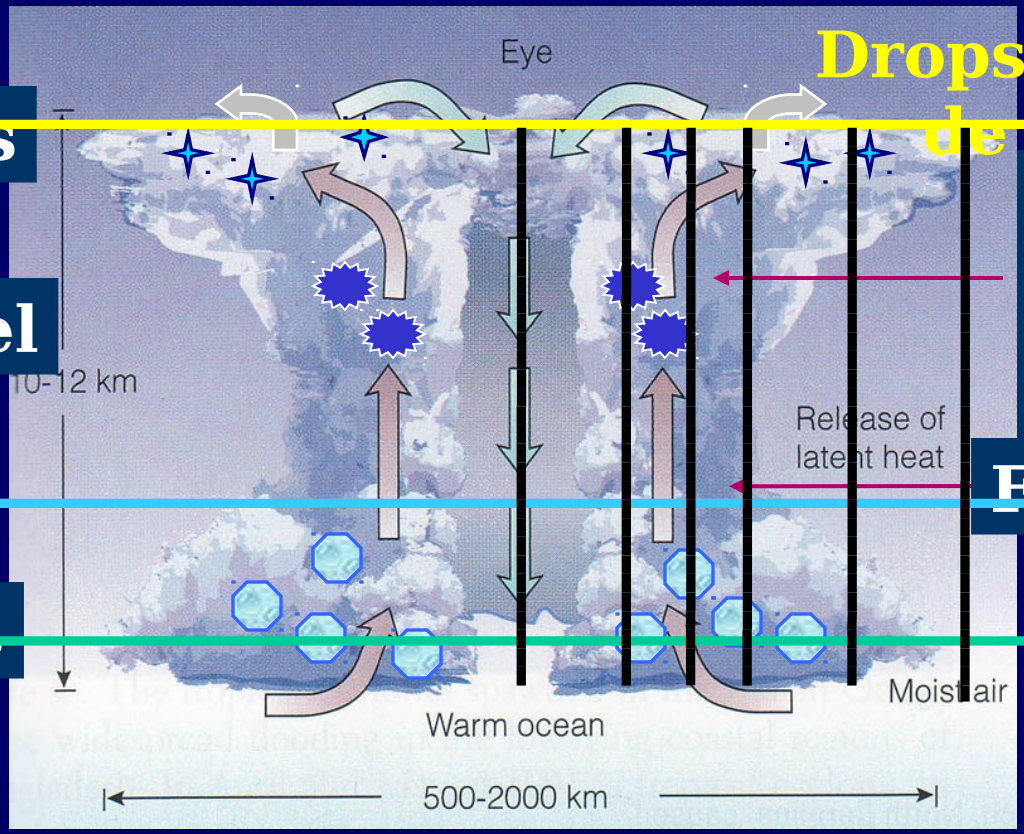
Analysis of Sat-Based TC Intensity Estimation in the WNP

Comparison of All Satellite-based Estimates – Vmax (Kts)

N=13	'Blind' Dvorak Consensus	Oper Dvorak Consensus (w/Koba)	ADT w/MW	CIMSS AMSU	SATCON
Bias	2.9	1.4	-5.8	3.1	0.2
Abs Error	9.1	12.3	12.8	9.2	9.1
RMSE	11.8	14.8	16.6	10.7	11.1

Positive Bias indicates method estimates are too strong

High Level Invests (30,000’)



Ice Crystals
30,000’

Hail/Graupel

10,000’

Raindrops
1,500’

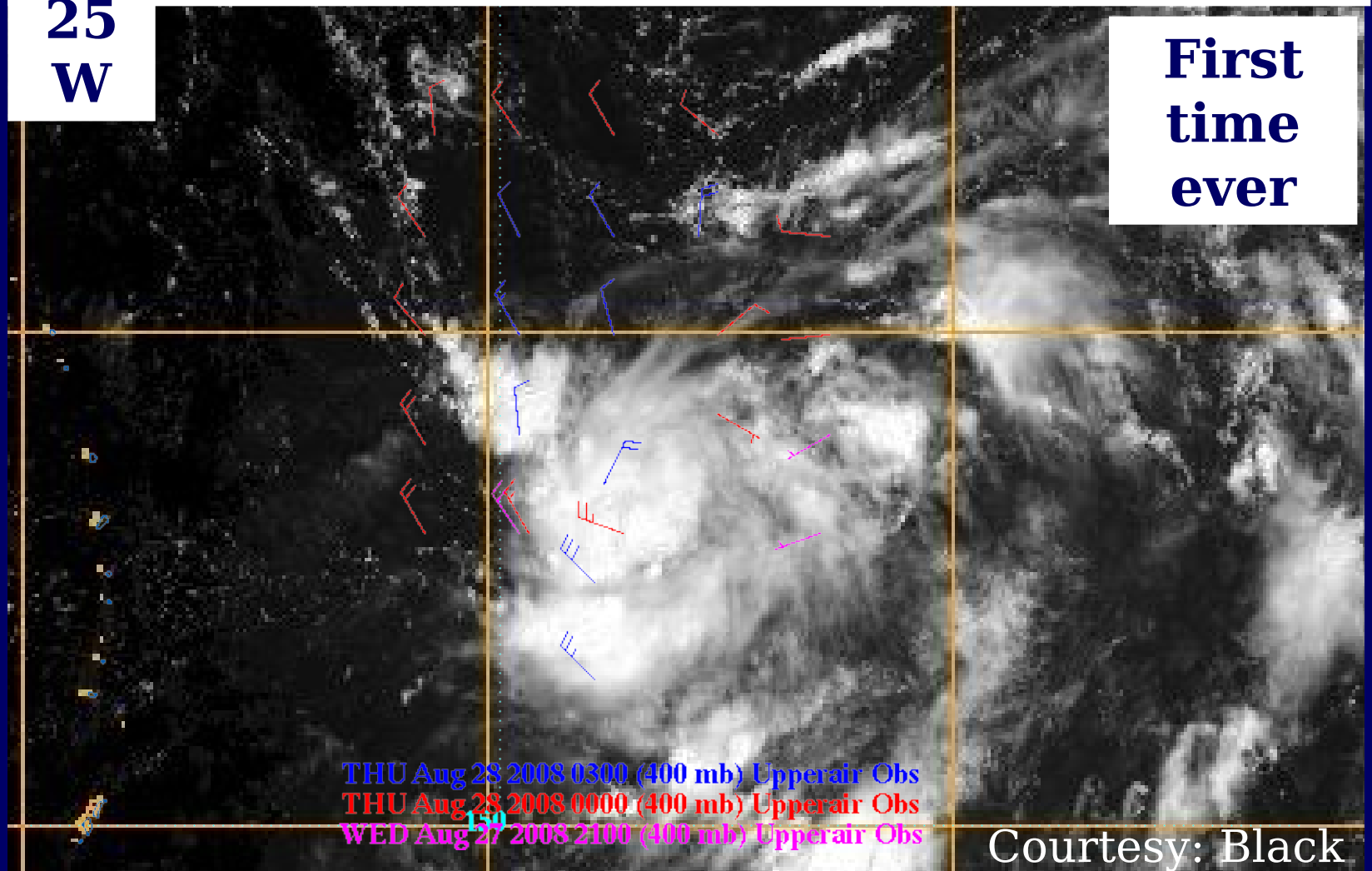
Dropsonde

Effective Level of hydrometeors

Freezing level

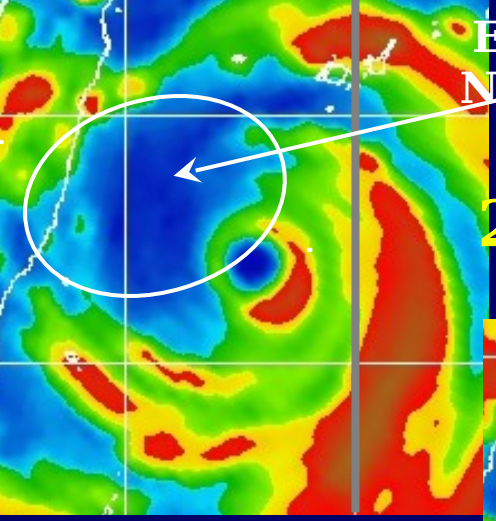
TCS-08 Shear Impacts on TCs

High altitude (30,000') dropsondes enable shear studies



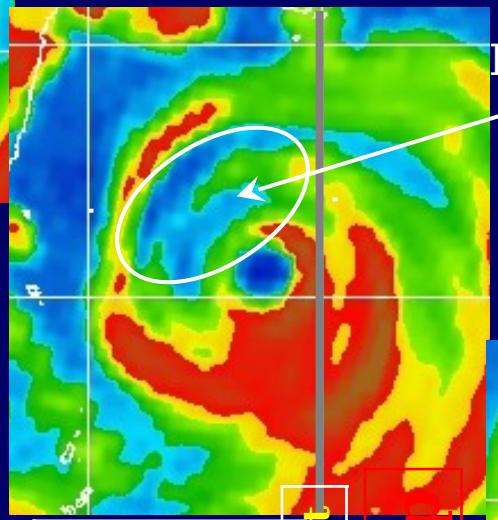
Rapid Structure Chang

STY Jangmi



Eyewall open west, NW quad rainbands disappear

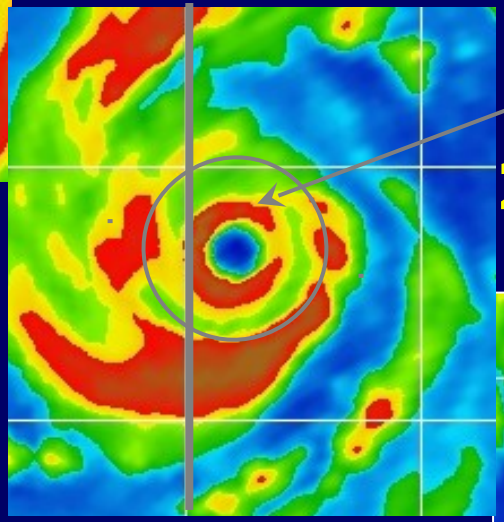
27 Sept, 2132



Eyewall, bands decay

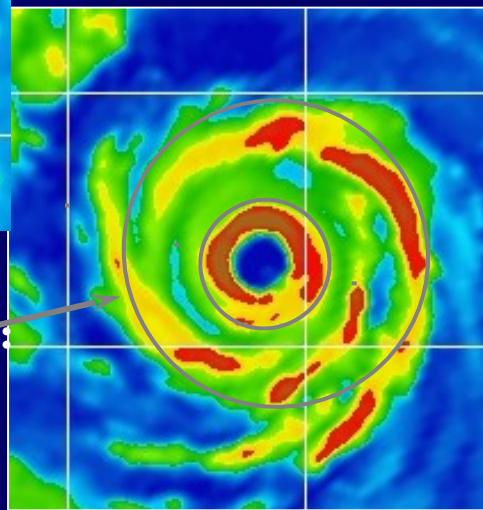
27 Sept, 1134

28 Sept, 0006



Eyewall shrinks, asymmetric band structure forms

27 Sept, 0445



Concentric Eyewalls: Peak Intensity

Time

Cold, Shallow

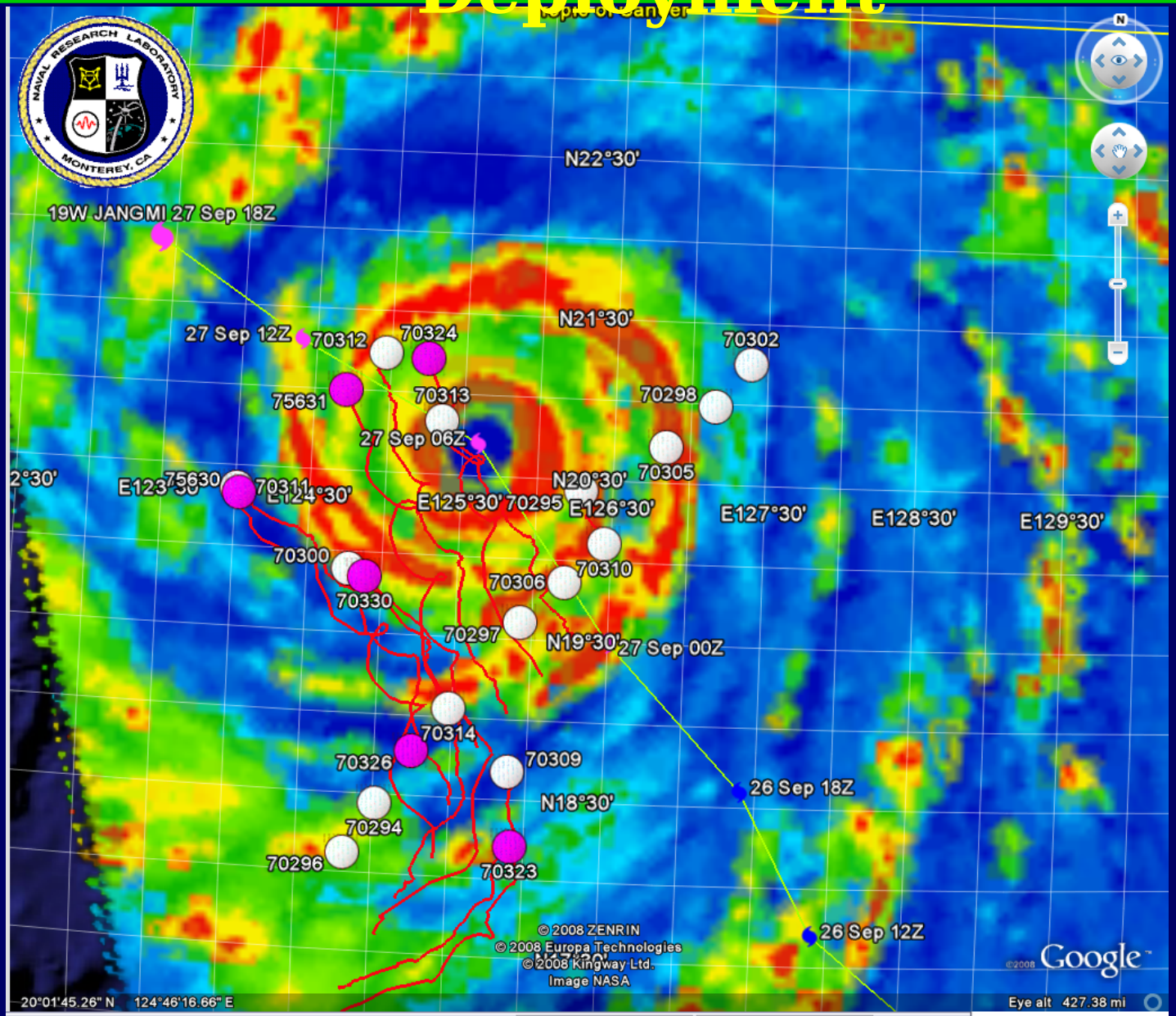
OHC Gradient

Warm, Deep

Black

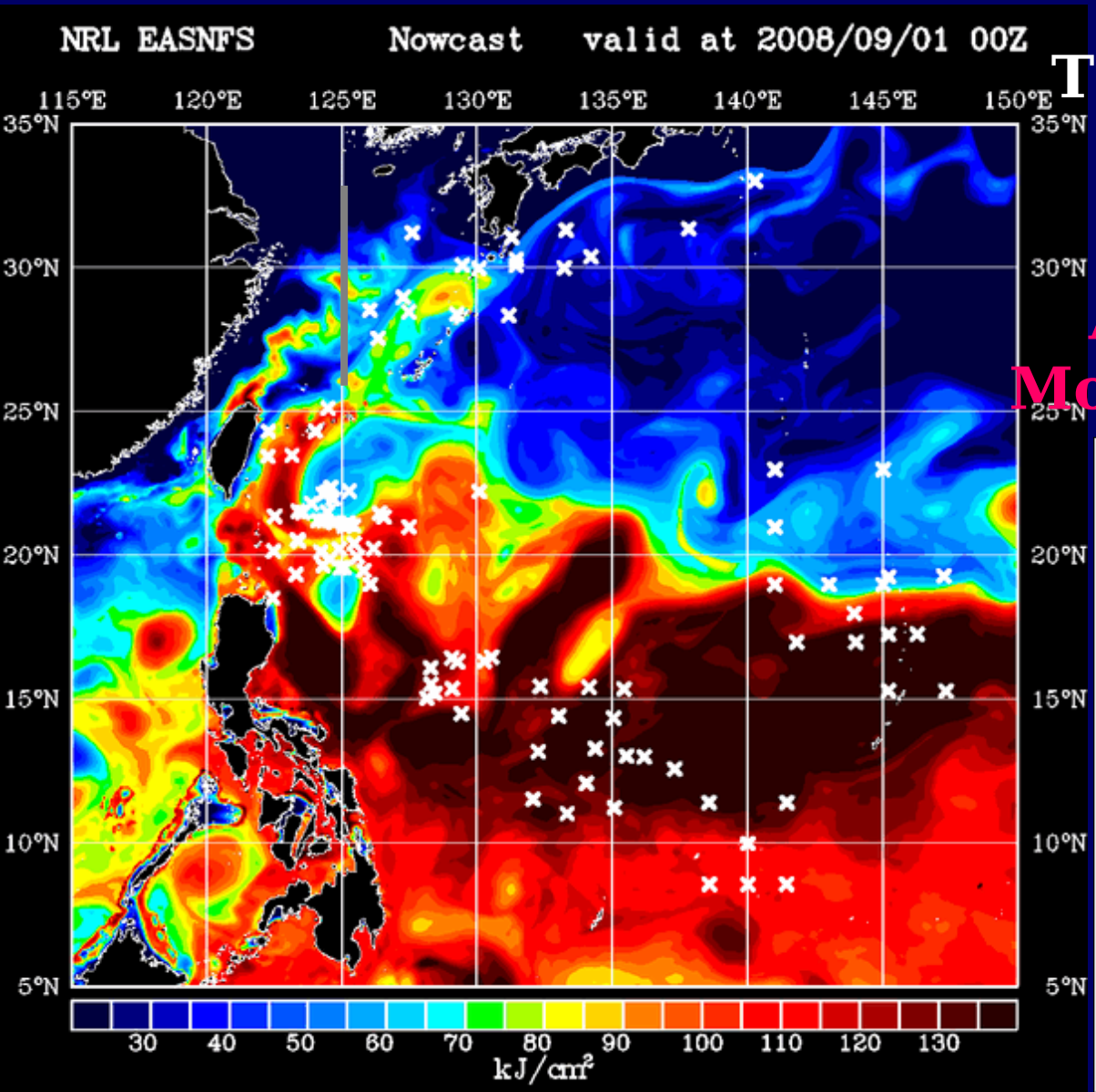
Revolutionary Research . . . Relevant Results

WC-130J Drifting Buoy Deployment



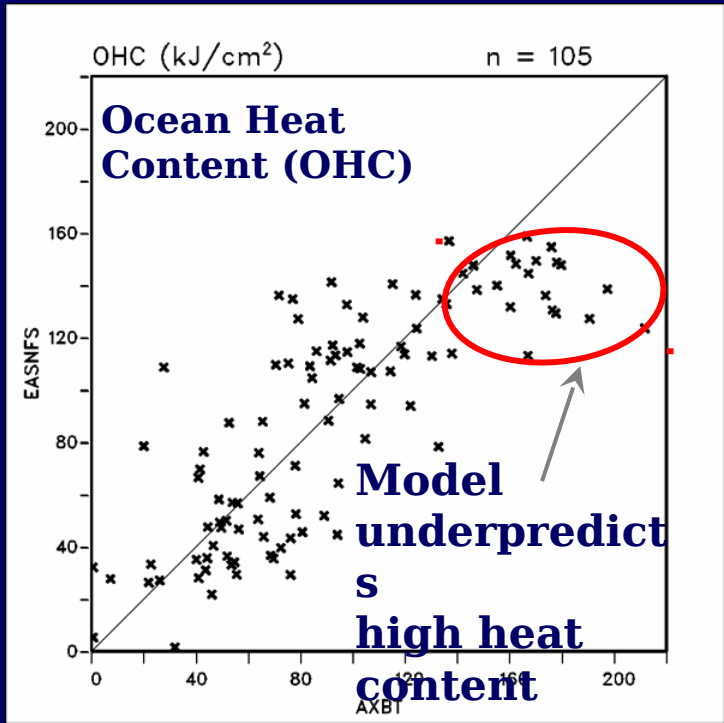
TCS-08 Ocean Heat Content:

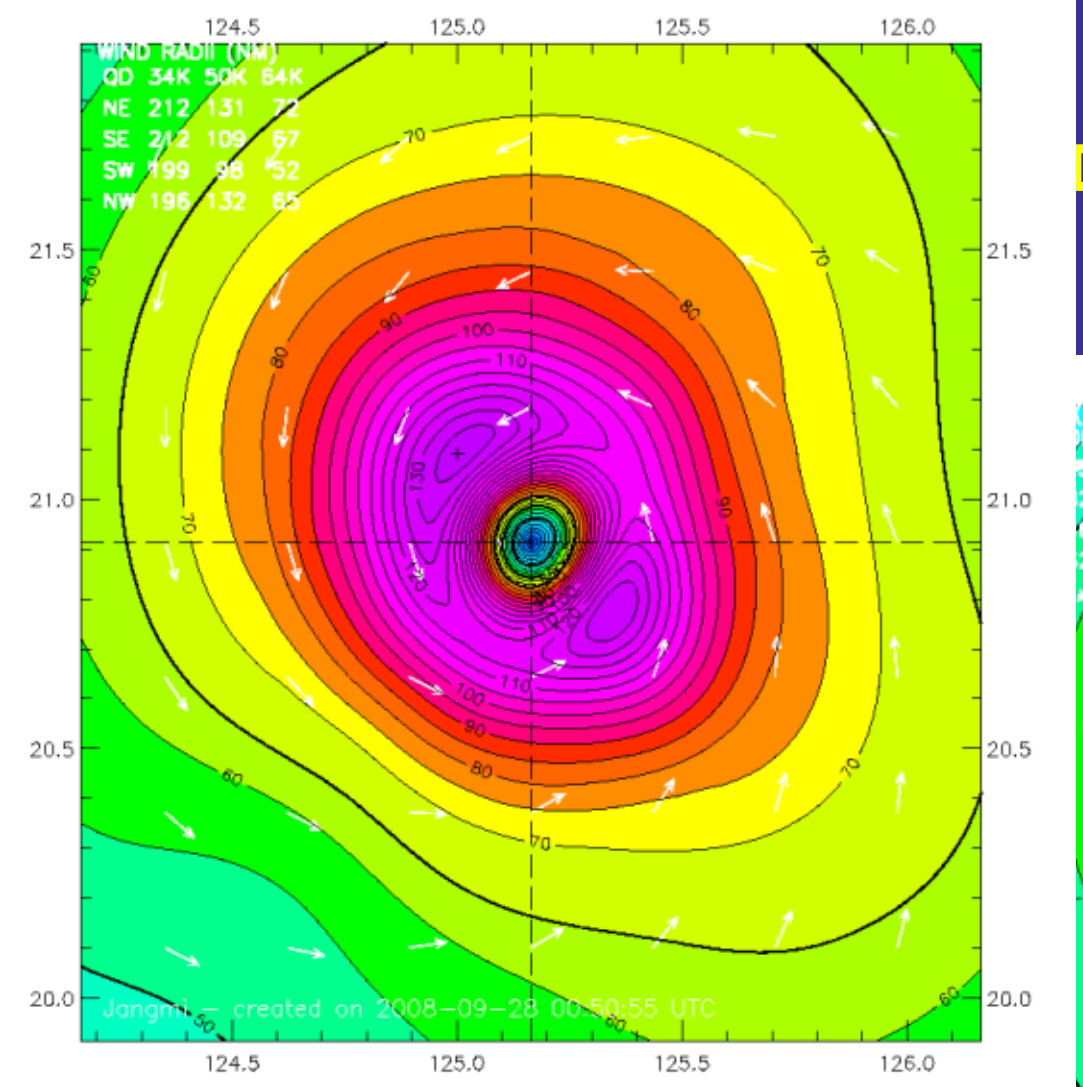
Preview of ITOP2010



TCS08 AXBT Location
Ko, NRL Stennis

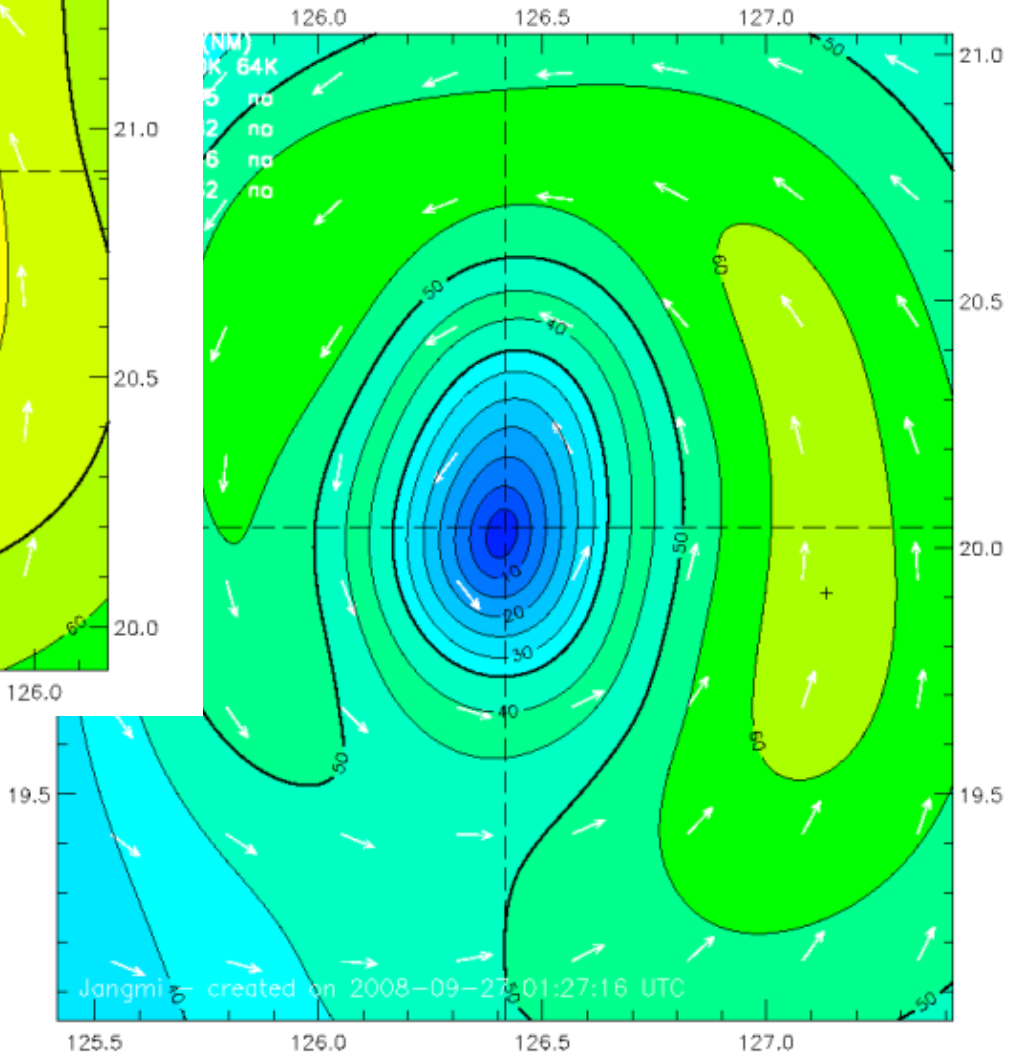
AXBT vs NRL Ocean Model Initial Condition



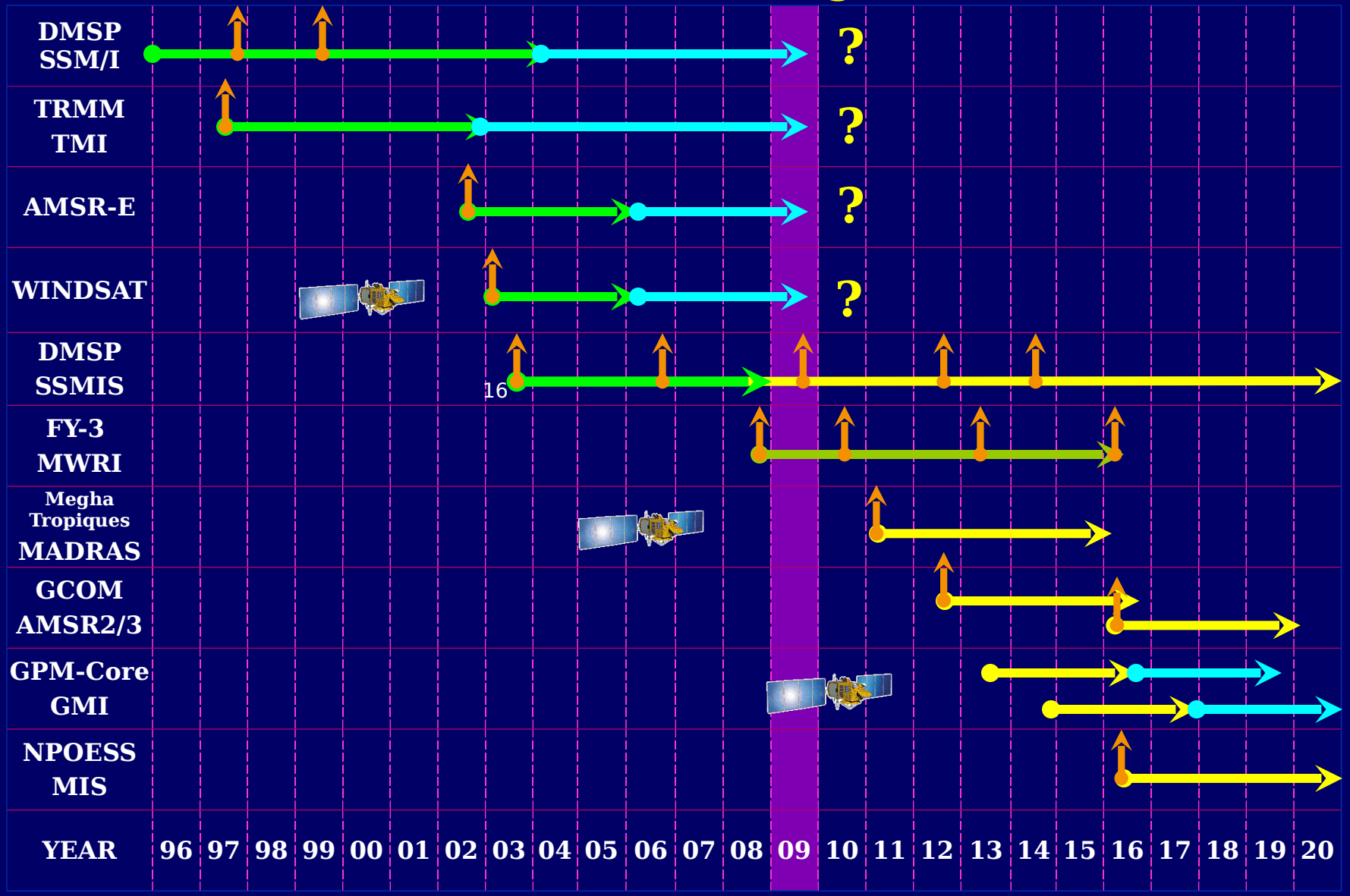


WC-130J
SFMR data defines more accurate TC intensity and size

QSCAT- and ASCAT-only Data over-estimates size and under-estimates intensity



Passive Microwave Imager Missions



Primary mission

Launches

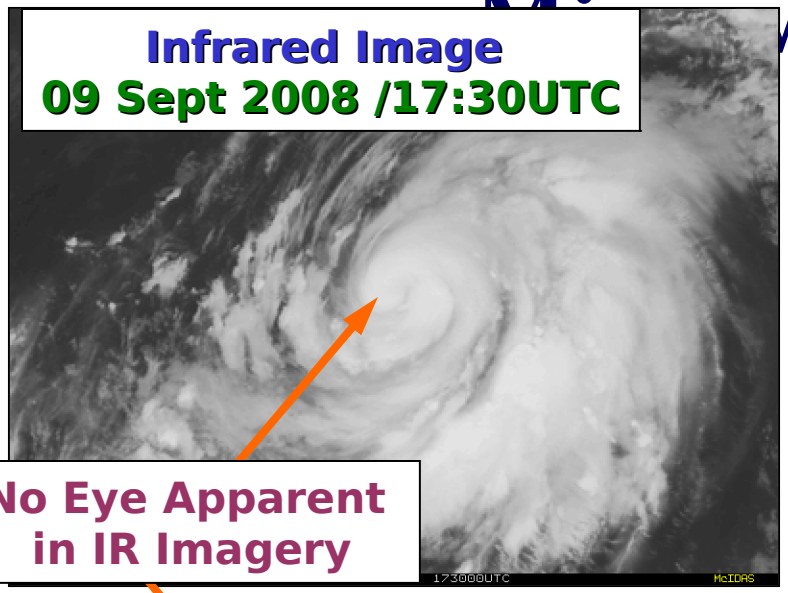
Projected extended mission

Future

April 2009
Hawkins-Hou-Ferraro

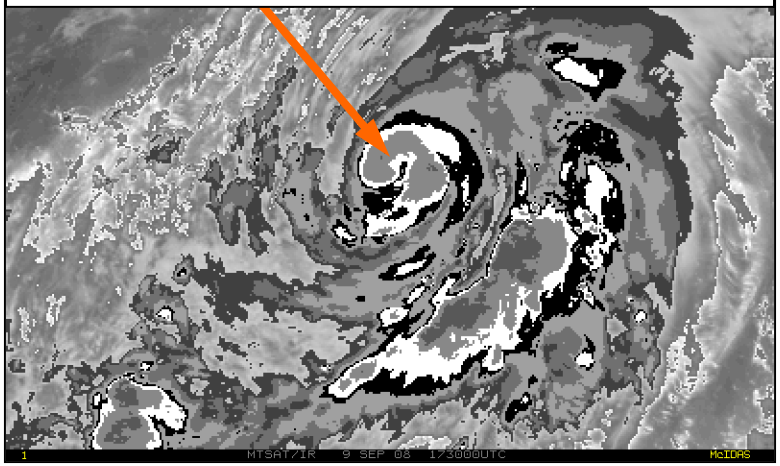
Advanced Dvorak Technique (ADT)
Microwave (ADT-MW)

Infrared Image
09 Sept 2008 /17:30UTC

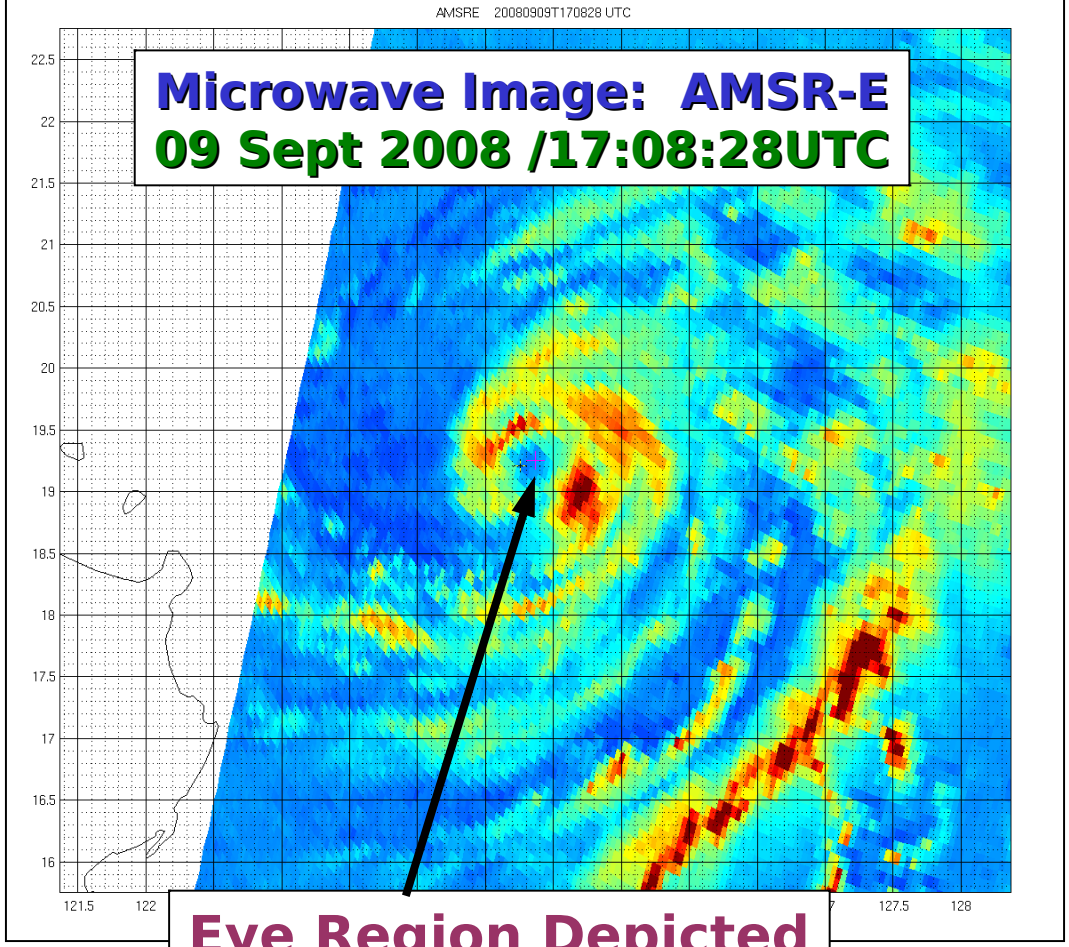


No Eye Apparent in IR Imagery

"Dvorak" Enhancement
09 Sept 2008 /17:30UTC



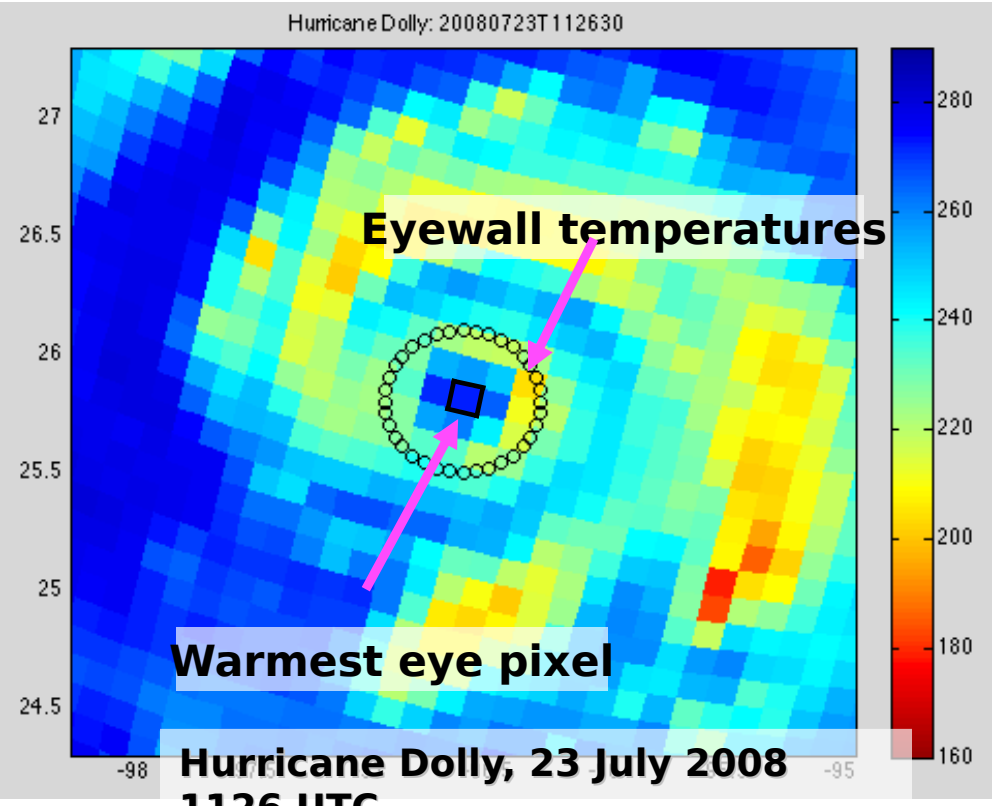
Microwave Image: AMSR-E
09 Sept 2008 /17:08:28UTC



Eye Region Depicted In MW Imagery

ADT-MW Module

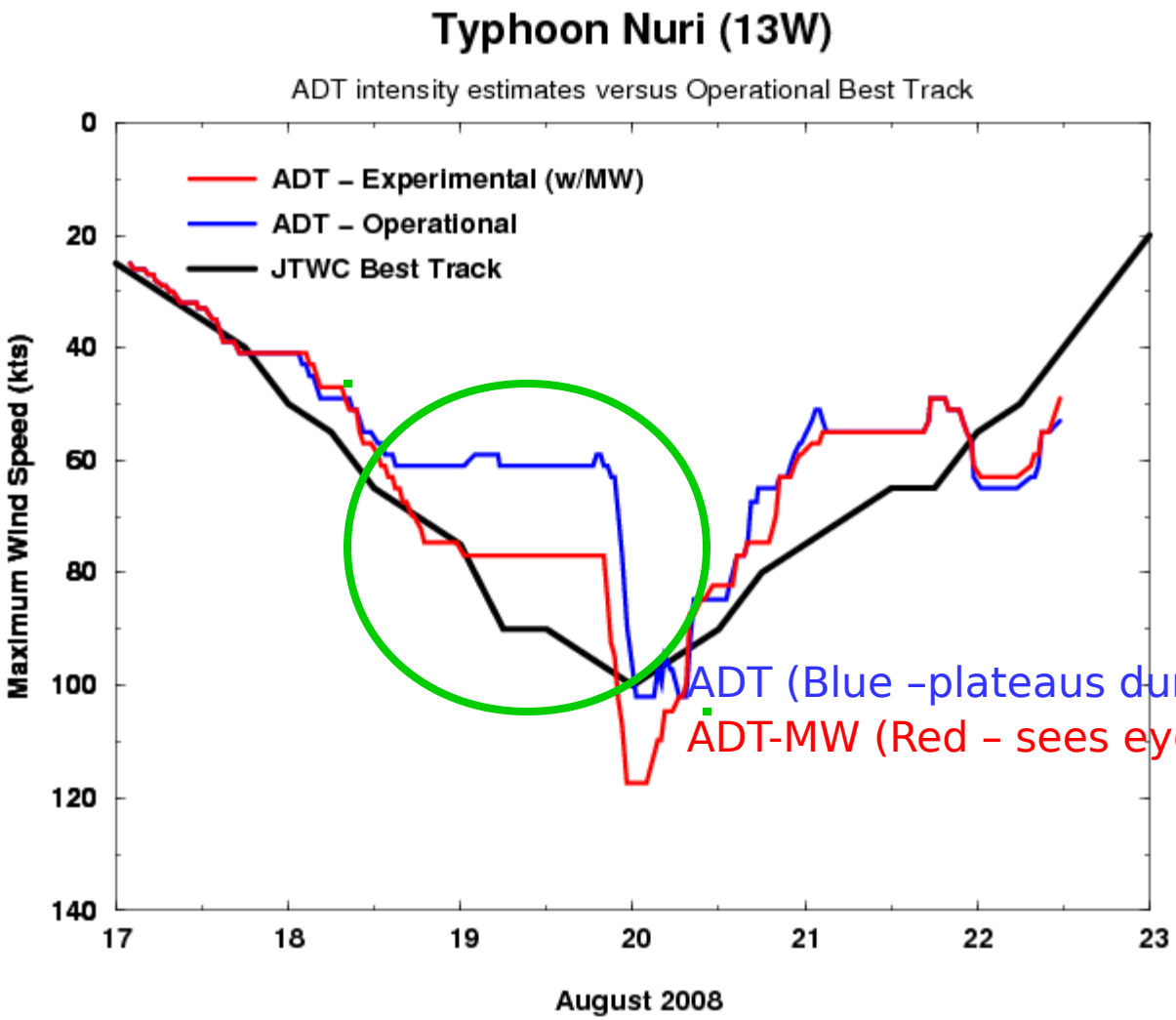
Augments ADT by monitoring eyewall structure via microwave imagery during eye formation stages obscured by upper clouds (CDO)



SSM/I 85GHz brightness temperatures (T_B)

- **Uses T_B discriminators to analyze TC core structure and output "scores" related to TC intensity**
  - **Scheme estimates storms:**
    - **Greater than 65 knots**
    - **Greater than 85 knots**
  - **Scores exceeding thresholds in these intensity bins are passed to ADT with Current Intensity (CI) values which override ADT IR-based estimates**
- **6.4 Demo Transition in**

ADT-MW Example



ADT (Blue –plateaus during CDO)

ADT-MW (Red – sees eyewall development